

Lamellitrochus, a New Genus of Solariellinae (Gastropoda: Trochidae), with Descriptions of Six New Species from the Western Atlantic Ocean

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ABSTRACT

Lamellitrochus new genus is erected for eight western Atlantic species of Solariellinae. The genus is distinguished by having conicoturbinat shells with angular whorls; strong, usually lamelliform axial riblets that usually become obscure or are absent on last whorls; strong subsutural angulation bearing rounded, conical, or lamellate tubercles; strong, smooth to tuberculate peripheral carina; strong, circumbasal carina; intritacalx-like outer shell layer; usually micropustules on early whorls; and radula lacking a lateromarginal plate. Included in *Lamellitrochus* are the type species, *Margarita lamellosa* Verrill & Smith, 1880; *Solariella pourtalesi* Clench & Aguayo, 1939; and six new species: *L. incertatus*, *L. carinatus*, *L. suavis*, *L. filiosus*, *L. fenestratus*, and *L. bicoronatus*.

Key words: Gastropoda; Trochidae; Solariellinae; *Lamellitrochus*; systematics, new species.

INTRODUCTION

The Solariellinae Powell, 1951, was erected for trochid genera having short radulae with reduced numbers of marginal teeth (usually 10 or fewer pairs per row). More recent work has shown that features of the external anatomy (a broad, fringed snout; propodium with lateral horns; reduced epipodium) are also characteristic of the subfamily (Fretter & Graham, 1977; Herbert, 1987; Hickman & McLean, 1990). Although the subfamily is well defined, Herbert (1987) has shown that animals with similar shell characters can have different radulae, and that assignment of these species to genera based solely on shell characters is sometimes inadvisable. Indeed, this is reflected in the low number of extant genera (10) recognized at present (Hickman and McLean, 1990). Despite the obvious convergence of shell characters of many species, some species defy ready assignment to existing genera. Eight such species occur in the western Atlantic Ocean, and the genus *Lamellitrochus* is proposed to include those taxa.

Institutional abbreviations used in this paper are as

follows: DMNH (Delaware Museum of Natural History, Wilmington, Delaware); FSBC I (Florida Marine Research Institute, St. Petersburg, Florida); MNHN (Muséum National d'Histoire Naturelle, Paris); MORG (Museu Oceanográfico da Fundação Universidade do Rio Grande, Rio Grande, RS, Brazil); UF (Florida Museum of Natural History, University of Florida, Gainesville, Florida); UMML (Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida); and USNM (National Museum of Natural History, Smithsonian Institution, Washington, DC).

SYSTEMATICS

Family Trochidae Rafinesque, 1815

Subfamily Solariellinae Powell, 1951

Genus *Lamellitrochus* Quinn new genus

Margarita: Verrill & Smith in Verrill, 1880:392 (*partim*); Verrill, 1880:378 (*in* 1880-1881); 1881:406; 1882:530, 531 (*partim*); 1885:527; Dall, 1881:40 (*partim*).

Margarita (*Solariella*): Dall, 1889a:378-382 (*partim*); 1889b:164 (*partim*); 1903:164 (*partim*); Pilsbry, 1890:307-330 (*partim*).

Solariella: Dall, 1927:128-130 (*partim*); Johnson, 1934:71 (*partim*); Clench & Aguayo, 1939:190, 191; Rice & Kornicker, 1965:117 (*partim*); Porter, 1974:21 (*partim*); Abbott, 1974:41 (*partim*); Treece, 1980:559.

Solariella (*Machaeroplax*): Abbott, 1974:40 (*partim*).

Solariella (*Solariella*): Quinn, 1979:37-42 (*partim*).

Diagnosis: Shell small (usually <10 mm); subsutural angulation tuberculate; peripheral carina prominent, smooth to tuberculate; umbilicus broad; sharp, usually lamellate axial riblets on early teleoconch whorls; microsculpture usually of irregular pustules; intritacalx-like outer shell layer; and oblique, circular to ovate aperture.

Description: Shell small, largest attaining height of about 10 mm but usually less than 5 mm, conicoturbinat, umbilicate, nacreous under thin intritacalx and white porcelaneous layers. Whorls tubular, shouldered, periph-

erally carinate, with prominent axial and spiral sculpture. Axial sculpture of strong, sharp lamellate riblets on first 2–4 teleoconch whorls; later whorls (when present) with discontinuous remnants of riblets, most prominent on spiral carinae, and weak to strong axial rugae; generally axially oriented micropustules on adapical surface of teleoconch whorls. Spiral sculpture above suture of strong cords or angulations, often tuberculate, and usually fine threads between angulations; peripheral carina strongest, tuberculate, undulate, or smooth. Base weakly convex to flat, bounded by strong, smooth carina, and with weak to strong, smooth or finely beaded spiral cords. Umbilicus broadly open, funnel-shaped, bounded by one (rarely two) strong, tuberculate spiral cord; walls usually with spiral cords and axial rugae. Aperture oblique, circular to ovate.

External anatomy typically solarielline, with broad snout having numerous, finger-like projections at tip; long, micropapillate cephalic tentacles; lateral extensions of the propodium; cephalic lappets lacking. Eyestalks small, slender, with terminal eye; right postoptic tentacle lacking. Epipodium reduced; left neck lobe represented by pair of short tentacles, anterior one near base of left cephalic tentacle, posterior one near base of anterior epipodial tentacle; right neck lobe simple or with small triangular extension, and may be partially fused to basal half of right eyestalk. Epipodium with 3 pairs of micropapillate tentacles; anterior pair long, about midway between cephalic tentacle and second pair; second pair long or short, near anterior edge of opercular lobe; posterior pair long, near posterior edge of opercular lobe; small, thin, triangular flap may be present between anterior 2 pairs.

Radula short, broad, with about 20–30 transverse rows of teeth; formula 6–8.4.1.4.6–8. Rachidian tooth cusp triangular, denticulate, excavated dorsally to accommodate next anterior rachidian tooth cusp; base triangular, articulating with inner lateral tooth base. Lateral teeth 4 pairs, similar to those of *Ilanga* (Herbert, 1987). Marginal teeth 6–8 pairs, denticulate on outer edge near tip. Lateromarginal plate lacking.

Type species (here designated): *Margarita lamellosa* Verrill & Smith, 1880.

Etymology: From the Latin *lamella*, a little blade, and *trochus*, a child's hoop; gender masculine.

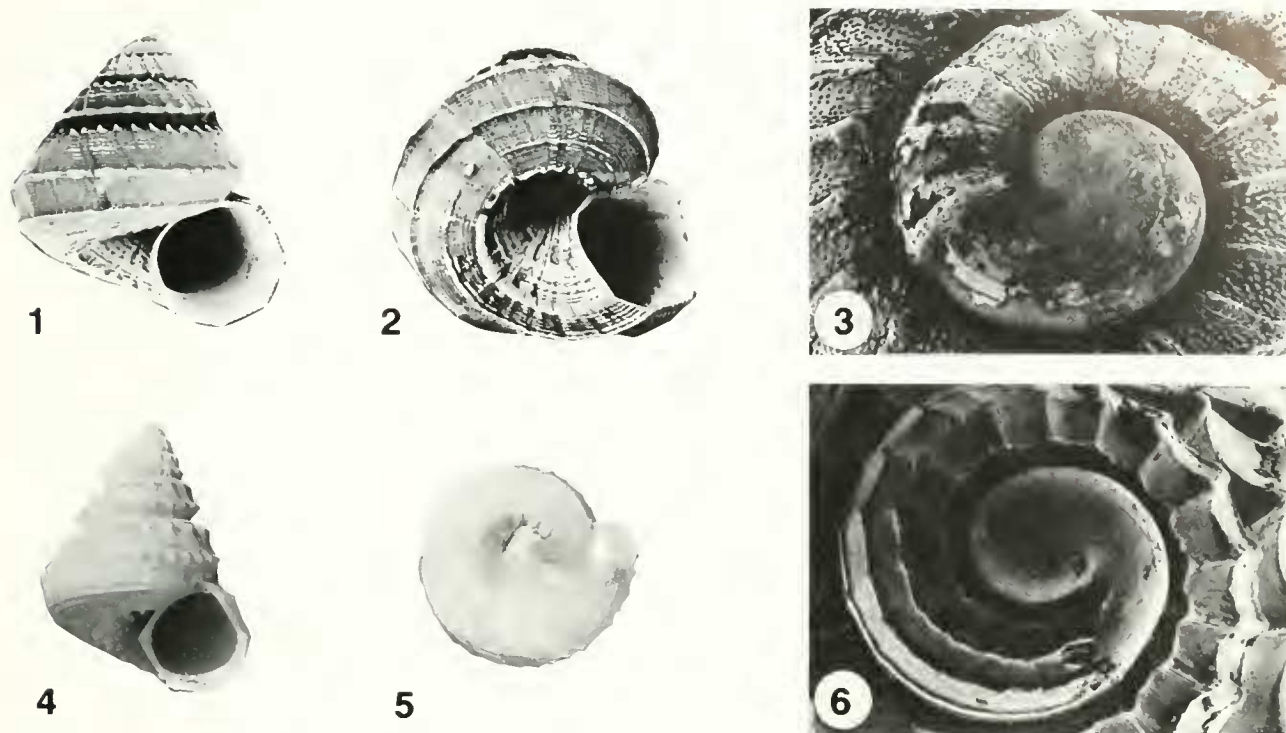
Included species: *Margarita lamellosa* Verrill & Smith, 1880; *Solariella pourtalesi* Clench & Aguayo, 1939; *Lamellitrochus carinatus* Quinn new species; *L. incertus* Quinn new species; *L. suavis* Quinn new species; *L. filiosus* Quinn new species; *L. fenestratus* Quinn new species; and *L. bicoronatus* Quinn new species.

Remarks: The shells of species assigned to *Lamellitrochus* are distinguished from all other solarielline genera by their strongly angular whorl profiles and distinctive macro- and microsculpture. The angular whorl profile is caused by the development of a strong subsutural angulation set with rounded, conical, or lamellate tubercles;

a strong peripheral carina that is smooth, undulate, or tuberculate; a strong basal carina that is usually smooth, but may be finely rugose; and a strong, tuberculate circumumbilical cord. The whorl surfaces between these angulations are almost flat, and usually have a varying number of fine spiral lirae. Several species currently assigned to *Solariella* Wood, 1842, also have shells with angulate whorl profiles: *S. triplostephanus* Dall, 1910; *S. patriae* Carcelles, 1953; and some forms of *S. cinctus* (Philippi, 1836) and *S. intermissa* Thiele, 1925. I have not examined specimens of the first two species, and illustrations and descriptions (Carcelles, 1953; McLean, 1971) are not detailed enough for me to determine the species' generic assignment; however, I doubt that these two species are congeneric with the *Lamellitrochus* species. Scanning electron micrographs of shells of *S. cinctus* (Fretter & Graham, 1977: fig. 32) and *S. intermissa* (Herbert, 1987: figs. 111, 112) reveal that neither species has micropustules on the early whorls.

An extremely thin, calcified shell layer, which may be chalky or polished, overlies the outer porcelaneous shell layer of the last one or two teleoconch whorls. This thin outer layer may be the calcified periostracum, or intritacalx, described by D'Attilio and Radwin (1971). Neither an intritacalx nor a periostracum have been reported for species of other solarielline genera, but they may have been overlooked; the systematic significance of the presence or absence of intritacalx in the Solariellinae is unknown at present. The surface of the first 2–3 whorls usually has a covering of micropustules, although the pustules may be restricted to the sutural area. In addition to those for *Solariella cinctus* and *S. intermissa*, SEM micrographs of the apical whorls of shells of *Ilanga* Herbert, 1987, *Spectamen* Iredale, 1924, *Minolops* Iredale, 1929, and *Zeminolia* Finlay, 1927 (Herbert, 1987), and *Minolia* Adams, 1860 (Hickman & McLean, 1990) have been published. Of the species illustrated, only the South African species *Spectamen adarticulatum* (Barnard, 1963) (see Herbert, 1987: fig. 124) has discernible micropustules. Conversely, *Lamellitrochus pourtalesi* seemingly lacks micropustules (figure 6). Micropustules also do not occur on shells of western Atlantic *Solariella*, *Microgaza* Dall, 1881, or *Suavotrochus* Dall, 1924 (personal observations), but are present in *Pagodatrochus* Herbert, 1989 (Herbert, 1989: fig. 4a,b).

Six of the eight species discussed in this paper have well-developed, usually lamellate axial riblets that appear on the first half-whorl, usually immediately following the terminal rim of the protoconch. Shells of a ninth species from Argentina (off Rio de la Plata, USNM 330860) also have this characteristic, but, because the two specimens are juveniles, this species is not described here. The illustrations of the first whorls of the genera cited above (Fretter & Graham, 1977; Herbert, 1987; Hickman & McLean, 1990) show that shells of other solarielline genera lack strong axial riblets on the first whorl, and that the riblets, present on later whorls are generally weaker, more rounded, and more closely spaced than those of *Lamellitrochus*.



Figures 1-6. 1-3. *Lamellitrochus lamellosus* (Verrill & Smith, 1880) from *Eolis* Station 351, SE of Fowey Light, Florida, 165 m (USNM 438440). 1. Apertural view, 11.6 ×. 2. Basal view (oblique), 12.7 ×. 3. Protoconch, 118 ×. 4-6. *Lamellitrochus pourtalesi* (Clench & Aguayo, 1939). 4, 5. Shell from *John Elliott Pillsbury* Station P-747, 11°46'N, 67°05.7'W, 1,175-1,098 m (UMML 30.6832). 4. Apertural view, shell height 9.1 mm. 5. Basal view, shell diameter 7.6 mm. 6. Protoconch of shell from *Alaminos* Station 69A11-S6, 21°41'N, 96°51'W, 969-1,079 m, FSBC 1 40300, 53 ×.

The radula of *Lamellitrochus* lacks any trace of a lateromarginal plate (figures 28-36) and resembles *Ilanga* Herbert, 1987, "some North Atlantic taxa" (Herbert, 1987:287), and possibly *Zetela* Finlay, 1927 (Herbert, 1987) in lacking this structure. Herbert (1987) used the presence or absence of a lateromarginal plate to assign species with similar shell morphologies to different genera, but he did not speculate on the broader systematic implications of the character because of the lack of detailed knowledge of many genus-level groups.

The presence of an intritacalx is the only character that seems to be unique to this species group, but in combination with presence of strong axial riblets and distinct micropustules on the early whorls of most species; presence of strong, usually tuberculate, subsutural and peripheral carinae; and lack of a lateromarginal plate of the radula, it supports establishment of a new genus-group taxon. Until more detailed analyses of shell and radular characters of more solarielline species groups are made, I prefer to treat *Lamellitrochus* as a genus rather than a subgenus of *Solariella*.

Lamellitrochus pourtalesi is illustrated here for comparison with the other species, but a complete species account is found in Quinn (1979).

Key to species of *Lamellitrochus*:

1. Protoconch diameter greater than 350 μ m 2
1. Protoconch diameter less than 350 μ m 3
2. Protoconch diameter 350-375 μ m; axial riblets present on first half-whorl ... *inecratus* new species
2. Protoconch diameter 525-550 μ m; axial riblets absent on first half-whorl
..... *pourtalesi* (Clench & Aguayo, 1939)
3. Tubercles on subsutural angulation lamellate 4
3. Tubercles on subsutural angulation conical or rounded 5
4. Axial riblets continuous between suture and periphery; shell wider than high; height less than 3 mm *carinatus* new species
4. Axial riblets not continuous from suture to periphery; shell higher than wide; height greater than 3 mm 5
5. Peripheral carina smooth to weakly undulate ...
..... *lamellosus* (Verrill & Smith, 1880)
5. Peripheral carina with strong, conical tubercles *filosus* new species
6. Subsutural angulation and circumumbilical cord formed by double rows of rounded tubercles ...
..... *bicoronatus* new species

6. Subsutural angulation and circumumbilical cord formed by single rows of conical tubercles 7
7. Axial riblets present on first half-whorl; peripheral carina tuberculate *suavis* new species
7. Axial riblets absent on first half-whorl; peripheral carina undulate *fenestratus* new species

Lamellitrochus lamellosus (Verrill & Smith, 1880)
(figures 1–3, 28–30)

Margarita lamellosa Verrill & Smith in Verrill, 1880:392, 397, 398.

Solariella (*Solariella*) *lamellosa*: Quinn, 1979:40, 42 (*partim*).

Description: Shell small, attaining 4.2 mm height, 3.55 mm width, conicoturbinate, peripherally carinate, broadly umbilicate, white, nacreous under thin outer porcelainous layer. Protoconch 280–310 μ m maximum diameter. Teleoconch whorls about 5, tubular, shouldered, carinate; first two whorls with strong, sharp, axial lamellae extending from suture to suture; axials becoming discontinuous or obsolete on subsequent whorls; micropustules rather strong, covering entire surface of first 1.5–2 whorls; subsutural angulation and peripheral carina appear on second whorl; subsutural angulation becoming strong, tuberculate, tubercles lamellate and closely set; peripheral carina becoming strong, tuberculate, but usually becoming smooth or irregularly undulate on last 1–2 whorls; as many as 13 weak spiral threads present between subsutural angulation and peripheral carina; as many as 12 weak spiral threads present between peripheral and basal carinae. Base flat, circumscribed by strong, smooth spiral carina; as many as 20 weak, smooth spiral cords present between basal carina and strong, tuberculate circumumbilical cord; umbilicus broadly open, 35–45% maximum shell diameter, funnel-shaped, walls with about 10 fine, weak spiral threads and weak axial rugae. Aperture oblique, circular, lips thin; peristome complete. Animal and radula as for genus.

Holotype: USNM 44738, height 3.0 mm, width 3.0 mm.

Type locality: Off Martha's Vineyard, Massachusetts, Fish Hawk Station 871, 40°02'54"N, 70°23'40"W, 210 m.

Other material examined: More than 100 lots in USNM, DMNH, FSBC I; see Quinn (in press) for listing.

Remarks: Shells of *Lamellitrochus lamellosus* are most similar to those of *L. filusos* in shape and in having lamellate tubercles on the subsutural angulation; however, the former species is absolutely and relatively larger (4.2 mm *vs.* 3.15 mm with about 5 whorls) but has a smaller protoconch (280–310 μ m *vs.* 315–325 μ m). The tubercles on the peripheral carina of shells of *L. filusos* are stronger, conical, and more widely spaced than those of *L. lamellosus*, and the spiral threads in the intercarinal spaces are weaker and the axial threads are stronger in *L. filusos* than in *L. lamellosus*. The shell of *L. suavis* is also very similar in shape and general sculpture, but the sub- tural tubercles are rounded, the periphery has rather strong tubercles, the micropustules are not as promi-

nent and are concentrated near the suture, and the intercarinal spiral sculpture is weaker than in *L. lamellosus*. *Lamellitrochus lamellosus* is distributed along the United States east coast from Massachusetts southward through the Florida Keys, and in the Gulf of Mexico off western Florida, Texas, and the Campeche Bank in depths of 50–250 m (usually in 100–200 m).

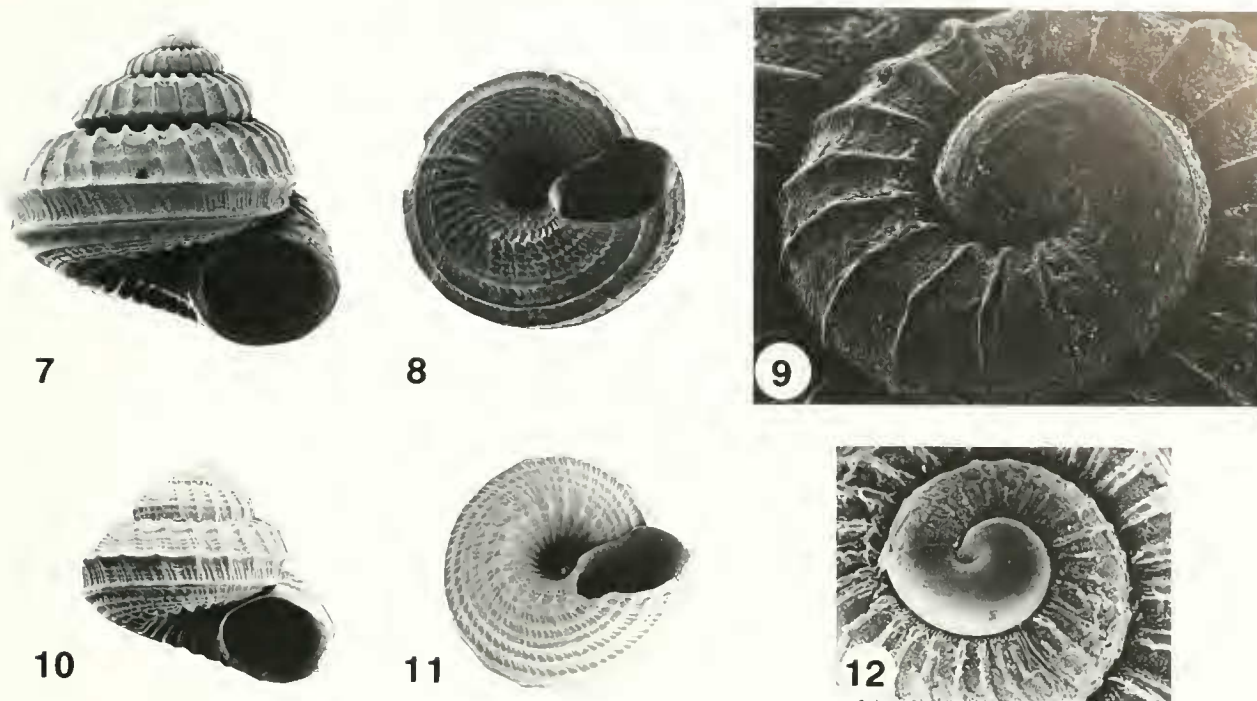
Lamellitrochus carinatus new species
(figures 7–12, 34, 35)

Description: Shell very small, attaining 2.75 mm height, 2.90 mm width, depressed conicoturbinate, peripherally carinate, broadly umbilicate, white, nacreous under thin outer porcelainous layer. Protoconch 275–300 μ m maximum diameter. Teleoconch whorls about 4, tubular, shouldered, carinate; first two whorls with strong, sharp, axial lamellae extending from suture to suture, but ending at or just above peripheral carina on subsequent whorls; micropustules rather strong, covering entire surface of first 2 whorls; subsutural angulation and peripheral carina appear on second whorl, peripheral carina becoming strong, smooth to weakly undulate; 1–7 weak spiral threads present between subsutural angulation and peripheral carina; 0–4 weak to strong spiral threads may be present between peripheral and basal carinae; whorl surface with microscopic pustules. Base weakly convex, circumscribed by strong, smooth spiral carina; 1–8 (usually 3–6) weak to strong, smooth to weakly undulate spiral cords present between basal carina and strong, tuberculate circumumbilical cord; umbilicus broadly open, 35–45% maximum shell diameter, funnel-shaped; walls with 1–7 weak spiral cords and strong axial rugae that radiate onto inner part of base, forming strong, radially elongate tubercles on circumumbilical cord. Aperture oblique, circular, lips thin, peristome complete.

Holotype: DMNH 179393, height 2.50 mm, width 2.70 mm.

Type locality: SW of Egmont Key, Florida, 366–421 m; J. Moore, collector.

Paratypes: DMNH 186768, 22 specimens; USNM 859408, 1 specimen; FSBC I 37633, 1 specimen; UF 161754, 1 specimen; all from same lot as holotype.—USNM 859431, 13 specimens; *Eolis* Station 360, off Fowey Light, Miami, Florida, 146 m.—USNM 438401, 3 specimens; *Eolis* Station 321, off Western Dry Rocks, Florida, 119 m.—31, DMNH 179392; 100 mi SW of Egmont Key, Florida; D. Steger, collector.—FSBC I 24259, 5 specimens; MAFLA Station 2746-41, 27°07'N, 84°13'W, 122 m; 23 August 1977; box corer.—USNM 500245, 37 specimens; State University of Iowa Barbados Station 29, off Lazaretto, 165–183 m.—USNM 500266, State University of Iowa Barbados Station 77, off Cable Station, 73–137 m.—MORG 26529, 1 specimen; *Marion-Dufresne* Cruise MD-55, Station DC-61, 20°29'S, 29°18'W, 63 m; May 1987; dredge.—MNHN uncatalogued, 1 specimen; *Marion-Dufresne* Cruise MD-55,



Figures 7-12. *Lamellitrochus carinatus* new species. 7-9. Paratypes from SW of Egmont Key, Florida, 366-421 m (DMNH 186768). 7. Apertural view, 15 \times . 8. Basal view, 17 \times . 9. Protoconch, 134 \times . 10-12. Paratype from *Marion-Dufresne* Cruise MD-55, Station DC-61, 20°29'S, 29°18'W, 63 m (MORG 26529). 10. Apertural view, 15.3 \times . 11. Basal view, 14.9 \times . 12. Protoconch, 82 \times .

Station DC-59, 20°30'S, 29°19'W, 52-60 m; May 1987; dredge.

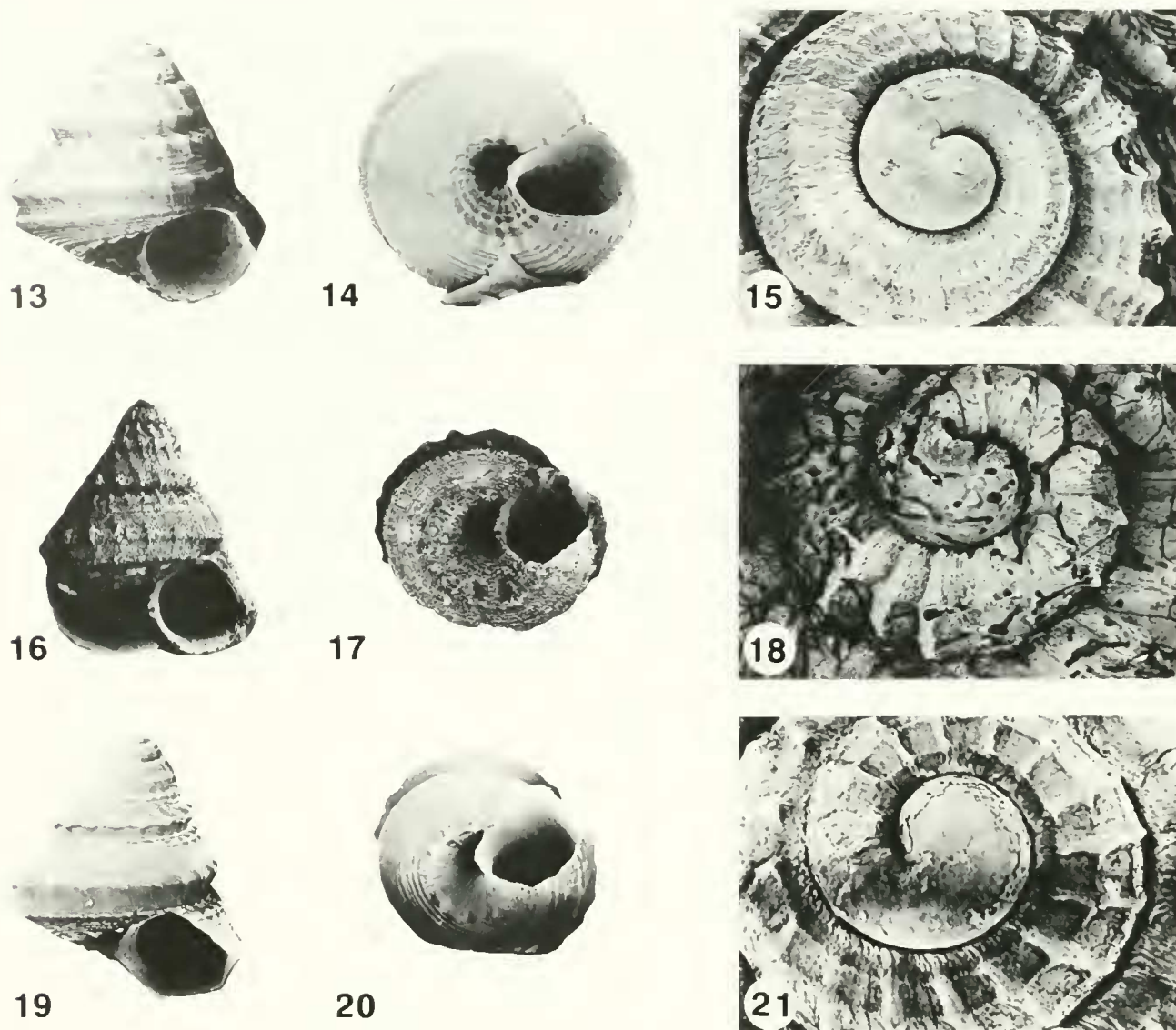
Other material examined: More than 50 lots in USNM and FSBC I; see Quinn (in press) for listing.

Remarks: Shells of *Lamellitrochus carinatus* are distinguished from those of all other *Lamellitrochus* species principally in being distinctly wider than high and usually having strong and continuous axial riblets on all whorls. This species also has the smallest shells, with heights of 2.50-2.75 mm and widths of 2.75-2.90 mm; adult shells of all other species exceed 3 mm in height. Variation in shell morphology occurs between northern and southern populations, but this is a reflection of the frequency of individual character states because the same variations also occur within individual populations. Shells of the northern (Florida) populations tend to have smooth to weakly undulate peripheral carinae; 2-4 strong, often unequally sized basal spiral cords; fewer, usually weaker spiral threads in the spaces between the subsutural angulation and peripheral carina (usually 1-3), and the peripheral and basal carinae (0-1); and narrower spaces between the axial riblets (about 0.15-0.20 mm apart on the third whorl). Shells from Barbados and Brazil usually have distinctly undulate peripheral carinae, the crests of the undulations often sharp; the basal spiral cords tend to be more numerous (usually 3-6, sometimes 7 or 8) and often equally sized and spaced; spiral threads in the intercarinal spaces are relatively numerous (usually 3-4

in each) and distinct; and the axial riblets are more widely spaced (about 0.25 mm apart on third whorl). This species is the most widely distributed of all *Lamellitrochus* species, ranging from off North Carolina southward to both sides of Florida; off Cuba, Puerto Rico, Antigua, and Barbados; and Trinidad Island off eastern Brazil, usually in depths of 100-200 m.

Lamellitrochus fencstratus new species
(figures 13-15)

Description: Shell small, attaining 3.35 mm height, 2.95 mm width, conicoturbinata, peripherally carinate, broadly umbilicate, white, nacreous under thin outer porcelaneous layer. Protoconch 275-300 μ m maximum diameter. Teleoconch whorls 4.6, tubular, shouldered, carinate; first 0.5 whorl with 4 spiral cords, increasing to 6 on second whorl; whorls 0.5-2 with initially weak, progressively stronger, rounded, axial riblets extending from suture to suture; axials becoming discontinuous or obsolete on subsequent whorls; micropustules weak, restricted to sutural area of first 2 whorls; subsutural angulation and peripheral carina appear on third whorl, peripheral carina becoming strong, undulate; 5-7 spiral threads present between subsutural angulation and peripheral carina; 2-5 weak spiral threads and distinct axial rugae present between peripheral and basal carinae. Base flat, circumscribed by strong, smooth spiral carina; 6-9 weak, smooth spiral cords present between basal carina



Figures 13–21. 13–15. *Lamellitrochus fenestratus* new species, paratype from off Barbados, 183 m (USNM 859429). 13. Apertural view, 14 ×. 14. Basal view, 14 ×. 15. Protoconch, 84 ×. 16–18. *Lamellitrochus filiosus* new species, holotype from off English Harbor, Antigua (USNM 500230). 16. Apertural view, 14.3 ×. 17. Basal view, 14.2 ×. 18. Protoconch, 91 ×. 19–21. *Lamellitrochus suavis* new species, holotype from off Barbados (USNM 500224). 19. Apertural view, 13.7 ×. 20. Basal view, 13.1 ×. 21. Protoconch, 92 ×.

and strong, tuberculate circumumbilical cord; umbilicus broadly open, 30–35% maximum shell diameter, funnel-shaped, walls with about 4 spiral cords and strong axial rugae. Aperture oblique, circular, lips thin; peristome complete.

Holotype: USNM 859428, height 3.15 mm, width 3.00 mm.

Type locality: Off Barbados, Blake Station (data unrecorded), 183 m.

Paratypes: USNM 859429, 4 specimens; from same lot as holotype—USNM 500202, 1 specimen; State University of Iowa Barbados Station 62, off Pelican Island, 229

m.—USNM 859430, 1 specimen; State University of Iowa Barbados Station (data unrecorded), “deep”.

Remarks: Shells of *L. fenestratus* are most similar to those of *L. bicoronatus* but differ in having only a single row of conical tubercles forming the subsutural angulation rather than a double row of rounded tubercles, in having a stronger peripheral carina with stronger tubercles, and in having a single rather than double circumumbilical cord. Shells of *L. fenestratus* are also similar to those of *L. filiosus* and *L. suavis* in size, protoconch width, and general shape, but differ from both in lacking axial riblets on the first half-whorl; in having conical tubercles in the subsutural angulation as in *L. filiosus*, but a more

undulate peripheral carina rather than that of *L. suavis*; and the spiral threads between the subsutural and peripheral carinae are stronger in *L. fenestratus* than in either *L. filusus* or *L. suavis*.

Lamellitrochus filusus new species
(figures 16–18)

Description: Shell small, attaining 3.15 mm height, 2.85 mm width, conicoturbinate, peripherally carinate, broadly umbilicate, white, nacreous under thin outer porcelainous layer. Protoconch 315–325 μm maximum diameter. Teleoconch whorls about 5, tubular, shouldered, carinate; first two whorls with strong, sharp, lamellate axial riblets extending from suture to suture; axials becoming discontinuous or obsolete on subsequent whorls; micropustules weak, restricted to sutural area on first 2 whorls; subsutural angulation and peripheral carina appear on second whorl; subsutural angulation becoming strong, tuberculate, tubercles lamellate; peripheral carina becoming strong, tuberculate; 13–15 very weak spiral threads present between subsutural angulation and peripheral carina; as many as 11 very weak spiral threads present between peripheral and basal carinae; spiral threads intersecting equally sized axial threads forming file-like surface sculpture. Base flat, circumscribed by strong, smooth spiral carina; as many as 20 weak, smooth spiral cords present between basal carina and strong, tuberculate circumumbilical cord; umbilicus broadly open, 40–45% maximum shell diameter, funnel-shaped, walls with 6–8 or more very weak spiral cords and weak, lamellate axial rugae. Aperture oblique, circular, lips thin; peristome complete.

Holotype: USNM 500230, height 2.75 mm, width 2.50 mm.

Type locality: State University of Iowa Antigua Station 116, off English Harbor, “deep”.

Paratypes: USNM 859425, 4 specimens; from same lot as holotype.

Remarks: Shells of *L. filusus* are most similar to those of *L. lamellosus*, particularly in having lamellate tubercles on the subsutural angulation, but differ in being smaller (3.15 mm vs. 4.20 mm, respectively, at whorl 4.9), in having strong, conical tubercles on the peripheral carina, and in having much weaker spiral threads between the subsutural carination and peripheral carina. Shells of *L. filusus* are also similar to the holotype of *L. suavis*, but have lamellate rather than conical tubercles on the subsutural angulation, and a fine, file-like sculpture on the surface of the last whorl.

Lamellitrochus suavis new species
(figures 19–21)

Description: Shell small, attaining 3.35 mm height, 2.90 mm width, conicoturbinate, peripherally carinate, broadly umbilicate, white, nacreous under thin outer

porcelainous layer. Protoconch 325 μm maximum diameter. Teleoconch whorls 4.6, tubular, shouldered, carinate; first two whorls with strong, sharp, lamellate, axial riblets extending from suture to suture; axials becoming obsolete on subsequent whorls; micropustules weak, scattered over entire surface of first 2.5 whorls; subsutural angulation and peripheral carina appear on second whorl; subsutural angulation becoming strong, tuberculate, tubercles bluntly conical; peripheral carina becoming strong, tuberculate; 5 weak spiral threads present between subsutural angulation and peripheral carina; 3 or 4 extremely weak spiral threads present between peripheral and basal carinae on last whorl. Base flat, circumscribed by strong, smooth spiral carina; 10 weak, smooth spiral cords present between basal carina and strong, tuberculate circumumbilical cord; umbilicus broadly open, 35% maximum shell diameter, funnel-shaped, walls with weak axial rugae. Aperture oblique, circular, lips thin; peristome complete.

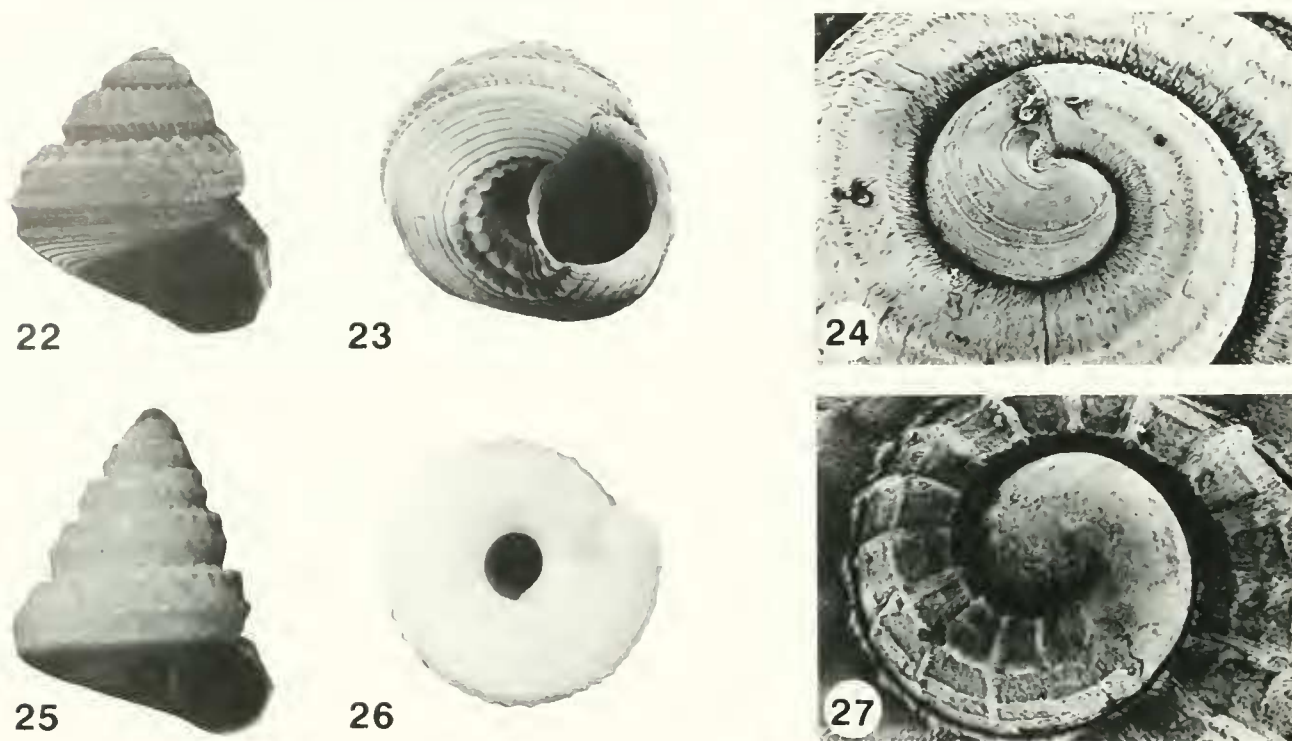
Holotype: USNM 500224, height 3.35 mm, width 2.90 mm.

Type locality: State University of Iowa Barbados Station (data unrecorded), “deep”.

Remarks: The shell of *L. suavis* resembles a miniature *L. incertus* in shell shape and sculpture, but is smaller and has a smaller protoconch (325 μm vs. 350–375 μm , respectively). Shells of *L. filusus* are similar to that of *L. suavis* in size, protoconch width, and tuberculate peripheral carina, but differ in having lamellate rather than conical tubercles on the subsutural angulation, and in having fine, crowded axial threads that interact with equally fine spiral threads to produce a fine, file-like sculpture on the whorl surface.

Lamellitrochus bicoronatus new species
(figures 22–24)

Description: Shell small, attaining 3.55 mm height, 3.20 mm width, conicoturbinate, peripherally carinate, broadly umbilicate, white, nacreous under thin outer porcelainous layer. Protoconch 290–300 μm maximum diameter. Teleoconch whorls 4.3, tubular, shouldered, carinate; first whorl with 5 strong spiral cords with additional threads appearing on second whorl and increasing in number on subsequent whorls; 3 cords, 1 just below suture, 1 above midwhorl, and 1 below midwhorl strengthening on second whorl, forming tuberculate subsutural and undulate shoulder angulations, and weakly undulate peripheral carina, respectively; low, rounded axial riblets appear at end of first whorl, becoming stronger and more lamellate on whorls 2–3, and becoming low, broad folds between suture and shoulder angulation on last whorl; micropustules weak, scattered over entire surface of first 2 whorls, but most concentrated near suture; last whorl with 3–4 spiral threads between subsutural and shoulder angulations, 5–7 spiral threads between shoulder angulation and peripheral carina, and 4–5 spiral threads and distinct axial rugae between pe-



Figures 22-27. 22-24. *Lamellitrochus bicoronatus* new species, paratype from off Barbados, 183 m (USNM 859436). 22. Apertural view, 13.1 ×. 23. Basal view, 14.3 ×. 24. Protoconch, 119 ×. 25-27. *Lamellitrochus inceratus* new species. 25, 26. Paratype from Gerda Station G-967, 24°15'N, 82°26'W, 499-503 m (UMML 30.8062). 25. Apertural view, shell height 8.3 mm. 26. Basal view, shell diameter 7.0 mm. 27. Protoconch of paratype from Albatross Station 2644, 25°40'N, 80°00'W, 353 m (USNM 859432), 81 ×.

peripheral and basal carinae. Base flat, circumscribed by strong, smooth spiral carina; 6-8 weak to strong, smooth spiral cords present between basal carina and 2 strong, tuberculate circumumbilical cords; umbilicus broadly open, about 40% maximum shell diameter, funnel-shaped, walls with 2-4 weak spiral cords and weak axial rugae. Aperture oblique, circular, lips thin; peristome complete.

Holotype: USNM 859435, height 3.55 mm, 3.20 mm.

Type locality: Off Barbados, Blake Station (data unrecorded), 183 m.

Paratypes: 4 specimens, USNM 859436; from same lot as holotype.

Remarks: Shells of *L. bicoronatus* differ from those of all other *Lamellitrochus* species in having most of the first teleoconch whorl devoid of axial riblets, and having a double spiral row of strong, rounded tubercles forming the subsutural angulation, and a similar double spiral row of tubercles circumscribing the umbilicus.

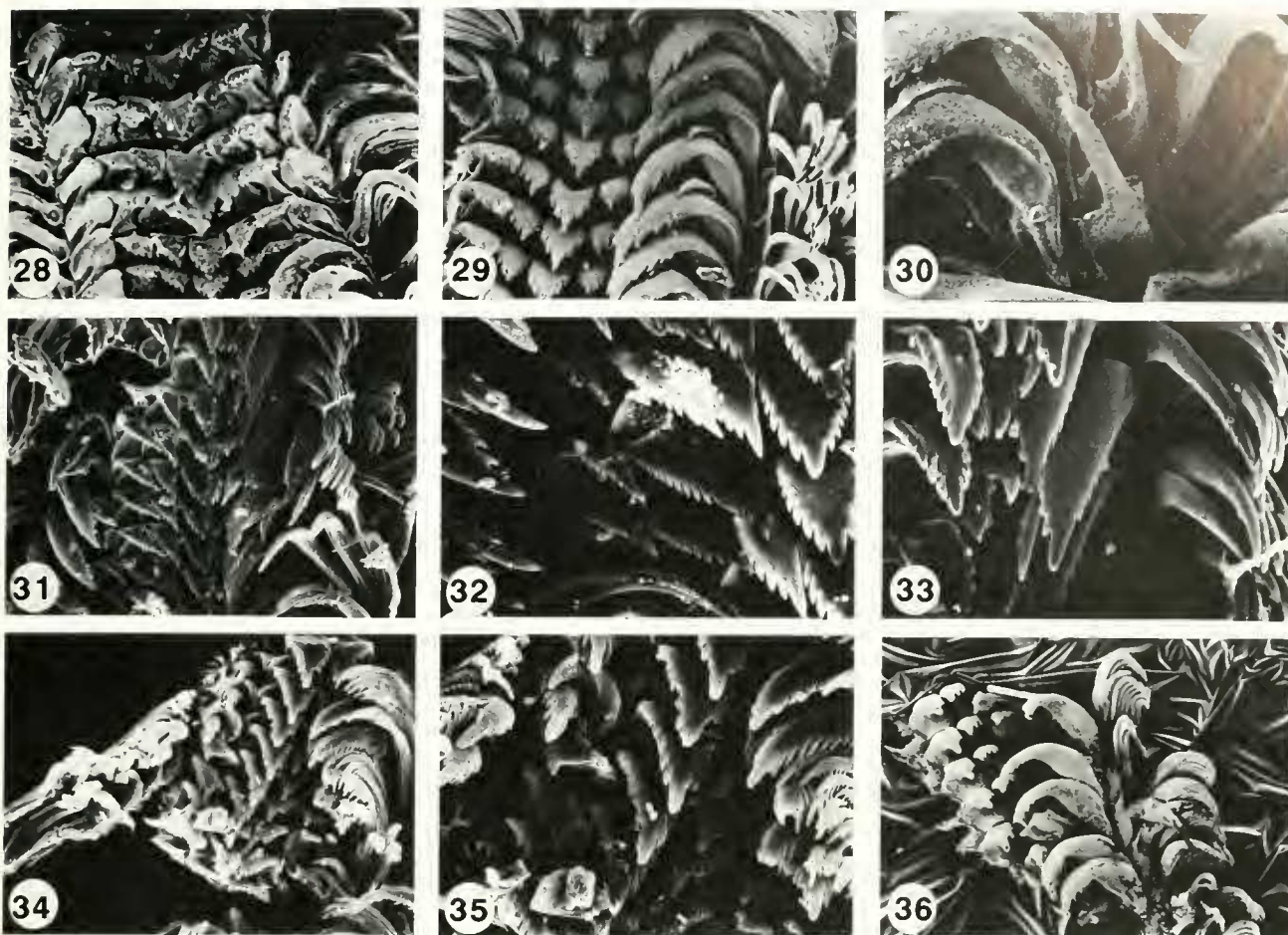
Lamellitrochus inceratus new species
(figures 25-27, 36)

Calliostoma tiara: Dall, 1889a:365 (partim).

Solariella amabilis: Dall, 1889a:378, 379 (partim)

Solariella (Solariella) lamellosa: Quinn, 1979:40-42, figs. 61, 62 (partim).

Description: Shell small, attaining 8.2 mm height, 7.3 mm width, conicoturbinata, peripherally carinate, broadly umbilicate, white, nacreous under thin outer porcelaneous layer. Protoconch 350-375 μm maximum diameter. Telcoconch whorls 6.0, tubular, shouldered, carinate; first whorl with strong, sharp, axial lamellae extending from suture to suture, rapidly becoming restricted to subsutural angulation and peripheral carina on subsequent whorls; micropustules rather weak, covering entire surface of first 2 whorls; first whorl with 2-4 weak spiral threads, two of which later interact with axial lamellae to form tuberculate subsutural angulation and peripheral carina; 0-5 very weak spiral threads present between subsutural angulation and peripheral carina; spiral threads absent between peripheral and basal carinae. Base flat, circumscribed by strong, smooth spiral carina; 5-11 weak, flat, smooth spiral cords present between basal carina and strong, tuberculate circumumbilical cord; center part of base often smooth; umbilicus broadly open, 45-50% maximum shell diameter, funnel-shaped, walls with 0-4 weak spiral cords and weak axial rugae. Aperture oblique, circular, lips thin; peristome complete.



Figures 28-36. Radulae of *Lamellitrochus* species. **28-30.** *Lamellitrochus lamellosus* (Verill & Smith, 1850) from specimen in Figure 1. **28.** Anterior segment, 339 \times . **29.** Middle segment, 339 \times . **30.** Anterolateral area, 690 \times . **31-33.** *Lamellitrochus pourtalesi* (Clench & Aguayo, 1939) from specimen in Figure 6. **31.** Middle segment, 240 \times . **32.** Rhachidian and laterals, 600 \times . **33.** Anterolateral area, 600 \times . **34, 35.** *Lamellitrochus carinatus* new species, from paratype from *Eolis* Station 360, off Fowey Rocks, Florida, 183 m (USNM 859431). **34.** Anterior segment, 600 \times . **35.** Same, 1,200 \times . **36.** *Lamellitrochus incertus* new species, from paratype in Figure 27, right anterior fragment, 169 \times .

Holotype: USNM 94946, height 7.05 mm, width 6.90 mm.

Type locality: Off Cape Florida, Key Biscayne, Florida, Albatross Station 2644, 25°40'N, 80°00'W, 353 m.

Paratypes: USNM 108141, 1 specimen; USNM 754272, 1 specimen; Albatross Station 2668, 30°58'30"N, 79°38'30"W, 538 m.—UMML 30.8051, 2 specimens; Gerda Station G-300, 26°16'N, 79°30'W, 640 m.—UMML 30.8025, 1 specimen; Gerda Station G-4, 25°49'N, 79°59.5'W, 256 m.—UMML 30.8338, 2 specimens; John Elliott Pillsbury Station P-1309, 25°44.5'N, 79°50.0'W, 311 m.—UMML 30.7565, 1 specimen; Gerda Station G-830, 25°40'N, 79°59'W, 342 m.—USNM 859432, 6 specimens; USNM 330559, 4 specimens; same locality as holotype.—UMML 30.8099, 2 specimens; Gerda Station G-23, 25°32'N, 79°44'W, 768 m.—UMML 30.8042, 2 specimens; Gerda Station G-857, 25°22'N, 80°03'W, 194-186 m.—UMML 30.7538, 1 specimen; Gerda Station

G-834, 25°15'N, 80°10'W, 86-79 m.—UMML 30.7914, 1 specimen; Gerda Station G-1035, 24°34.7'N, 80°58.6'W, 254-358 m.—UMML 30.7770, 8 specimens; Gerda Station G-970, 24°24'N, 82°08'W, 512 m.—UMML 30.8063, 1 specimen; Gerda Station G-969, 24°18'N, 82°33'W, 269-402 m.—UMML 30.7644, 1 specimen; Gerda Station G-968, 24°17'N, 82°34'W, 499-503 m.—UMML 30.8062, 6 specimens; Gerda Station G-967, 24°15'N, 82°26'W, 499-503 m.—UMML 30.8065, 1 specimen; Gerda Station G-1099, 24°12.5'N, 82°50'W, 622 m.—UMML 30.8058, 1 specimen; Gerda Station G-861, 24°08'N, 81°36'W, 514-558 m.—USNM 421840, 5 specimens; Waldo Schmitt Station 69, off Dry Tortugas, 455-655 m.—USNM 94947, 4 specimens; Blake Station 2, 23°14'N, 82°25'W, 1,472 m.—USNM 94948, 4 specimens; Blake Station 21, 23°02'N, 83°13'W, 525 m.—USNM 859433, 1 specimen; Blake Station (data unrecorded), Yucatan Channel, 1,170 m.—USNM 94058, 3 specimens; Albatross Station 2150, 13°34'45"N, 81°21'10"W, 699 m.—

USNM 94106, 1 specimen; *Albatross* Station 2135, 19°55'55"N, 75°47'07"W, 457 m.—USNM 429872, 5 specimens; USNM 429873, 2 specimens; USNM 429895, 2 specimens; Johnson-Smithsonian Deep-Sea Expedition Station 9-I, 18°37'45"N, 65°05'00"W, 549–860 m.—UMML 30.8339, 1 specimen; *John Elliott Pillsbury* Station P-929, 15°29.5'N, 61°11.5'W, 457–503 m.—USNM 94949, 2 specimens; *Blake* Station 211, 14°28'40"N, 61°06'05"W, 653 m.—UMML 30.8340, 8 specimens; *John Elliott Pillsbury* Station P-905, 13°46.3'N, 61°05.4'W, 381–963 m.—UMML 30.8341, 13 specimens; *John Elliott Pillsbury* Station P-904, 13°45.5'N, 61°05.7'W, 201–589 m.—UMML 30.8342, 1 specimen; *John Elliott Pillsbury* Station P-903, 13°44'N, 61°03.1'W, 231–430 m.

Remarks: Shells of *Lamellitrochus incertus* are similar in shape and sculpture to that of *L. suavis*, but are much larger (up to 8.2 mm *vs.* 3.35 mm, respectively) and have larger protoconchs (350–375 μ m *vs.* 325 μ m, respectively). Shells of *L. pourtalesi* (figures 4–6) are most similar to those of *L. incertus*, but are somewhat larger (to 10.3 mm), have much larger protoconchs (525–550 μ m), have a narrower umbilicus (about 35% *vs.* 45–50% of shell width, respectively), lack axial riblets on the first 0.5 whorl, the aperture is ovate rather than circular, and the tubercles on the subsutural angulation and peripheral carina are sharply conical and axially elongate rather than rounded and spirally elongate as in *L. incertus*. *Lamellitrochus incertus* occurs off southern Georgia; in the Straits of Florida from off Cape Florida to the Dry Tortugas, and off Havana and Bahia Honda, Cuba; in the Yucatan Channel; off Old Providence Island; off southeastern Cuba; off northern Puerto Rico; and the Lesser Antilles from Dominica to St. Lucia. This species is usually collected in depths of about 250–550 m.

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